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OFFICE OF MANNED SPACE FLIGHT
PROGRAM DIRECTIVEM-D MA 1400.105
(Project)

DATE

12/2/68

APOLLO PROGRAM DIRECTIVE NO. 6B *

TO : Distribution

FROM:

APOLLO PROGRAM DIRECTOR

OFFICE OF PRIME RESPONSIBILITY: MAP-6

SUBJECT: Key Inspection, Review and Certification Checkpoints and Their
Documentation

- REFERENCES:
- (a) M-D MA 500, Apollo Program Development Plan
 - (b) NPC 500-1, Apollo Configuration Management Manual
 - (c) NHB 5300.1A, Apollo Reliability and Quality Assurance Program Plan
 - (d) NHB 8080.1, Apollo Test Requirements
 - (e) NPC-200 Series, Reliability and Quality Program Provisions
 - (f) M-D MA 1400.007, Design Certification Review - Apollo Program Directive No. 7
 - (g) M-D MA 2210.008, Flight Readiness Review - Apollo Program Directive No. 8

I. PURPOSE

The purpose of this directive is to identify, list and briefly describe the key inspections, reviews and certifications which are required as control checkpoints for the Apollo Program. These key checkpoints are oriented to the hardware and software development and mission phases of the program to assure the adequacy of system design, manufacture and testing prior to mission accomplishment.

II. SCOPE

This directive covers the requirements, responsibilities, conduct and resultant reporting of the following key checkpoints.

- A. PDR - Preliminary Design Review
- B. CDR - Critical Design Review
- C. FACI - First Article Configuration Inspection
- D. CARR - Customer Acceptance Readiness Review
- E. COFW - Certificate of Flight Worthiness
- F. DCR - Design Certification Review (APD No. 7 for full coverage)
- G. FRR - Flight Readiness Review (APD No. 8 for full coverage)

Supersedes APD 6A dated August 30, 1966. Revisions are denoted by bars in the margins.

Additionally, details on these checkpoints have been developed in the reference documents and resulting Center implementation should reflect this total picture.

Under terms of this directive either or both a CARR and FACI may be held with the understanding that the objectives of FACI, as defined in NPC 500-1 (Ref. B), are accomplished by a CARR (Section V).

III. APPLICABILITY

The PDR, CDR, FACI, CARR, and COFW are conducted at the Contract End Item (CEI) level. The DCR and the FRR encompass the total system. Progression through each checkpoint is shown in Figures 1 and 2 along with the requirements, responsibilities, and resultant documentation.

The Apollo Test Requirements, NHB 8080.1; the Q&RA Program Plan, NHB 5300.1A; and NPC 200 Series documents contain general requirements for test, reliability and quality assurance. To the extent these requirements affect or pertain to Contract End Items, they should be reflected in the appropriate sections of the Contract End Item Specifications (Parts I & II) prepared to satisfy the requirements of NPC 500-1. The specification will then contain all the technical requirements imposed by APO documents and will serve, along with the drawing structure, as the primary document against which reviews, inspections and certificates will be accomplished.

It is recognized that it may be desirable from the Program Managers' viewpoint to conduct additional reviews, inspections and certifications to validate the compatibility of the Specifications, Drawings, Hardware and Test Results. Summaries of each of the key inspections, reviews and certifications are contained in Section V. Further detail for each is identified in the NPC 500-1, NHB 8080.1 and program directives for the Design Certification Review and the Program Director's Flight Readiness Review.

IV. Definition of terms can be found in Exhibit XVII of NPC 500-1.

V. REVIEW PROCEDURES

A. Preliminary Design Review (PDR) and Critical Design Review (CDR)

The PDR is a technical review of the basic design approach and is conducted prior to, or early in, the detail design phase. The CDR is a technical review of specifications and drawings conducted, ideally, prior to release of drawings for manufacture. However, in those cases wherein a PDR and CDR have not been accomplished, management emphasis will be directed to the conduct of the FACI. For further details refer to Exhibit XIV of NPC 500-1.

1. PDR - Preliminary Design Review

The purpose of a PDR is to formally review the design approach of a Contract End Item prior to, or very early in, the detail design phase.

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The PDR establishes:

- a. The compatibility of the selected design approach for the Contract End Item with the Contract End Item Spec. Part I.
- b. The system compatibility of the design approach by reference to predesign drawings, schematic diagrams, layout and envelope drawings, etc.
- c. The integrity of the design approach by review of analyses, breadboard models, mockups, circuit logic diagrams, packaging techniques, etc.
- d. The identification of the portions of the selected design approach to be subjected to detailed value engineering analysis.
- e. The producibility of the selected design approach by review of requirements for special tools and facilities.

The detail requirements are covered in NPC 500-1.

2. CDR - Critical Design Review

The purpose of a CDR is to formally review the design of a Contract End Item when the design is essentially complete and is intended to precede the release of engineering for manufacture. The CDR establishes:

- a. The compatibility of the Contract End Item as designed with the Contract End Item Spec. Part I.
- b. The system compatibility of the completed design by reference to ICD's, schematics and functional block diagrams.
- c. The integrity of the design by review of analytical and test data, and reliability apportionment and analysis available at that particular point in time.

The detail requirements are covered in NPC 500-1.

B. First Article Configuration Inspection (FACI) and Customer Acceptance Readiness Review (CARR)

1. FACI - First Article Configuration Inspection for KSC, MSFC and MSC End Items

The FACI examines a selected (earliest possible) manufactured end item (hardware and software) against the specification requirements, and released engineering drawings, and validates the acceptance testing. It may be necessary to reconduct the inspection, e.g., **Δ**FACI, one or more times to insure that the contractor has corrected deficiencies identified at the first inspection. These inspections will result in the establishment of a firm baseline of specifications and drawings.

Additionally, a FACI should be conducted on each major configuration departure from the basic hardware definition. Subsequent to FACI all end items will be accepted on a DD-250 (or equivalent) subject to all the requirements of acceptance contained in the specification and NPC 500-1.

The purpose of the FACI is to establish the Product Configuration Base-line for the Contract End Item. It is accomplished by establishing the exact relationship of the Contract End Item as described by released engineering to the Contract End Item as manufactured and assembled. The products of a FACI include:

- a. Acceptance of Part II of the Contract End Item Specification
- b. Validation of acceptance testing
- c. Comparison of the configuration of the end item unit undergoing First Article Configuration Inspection with the end item unit qualified or undergoing qualification if they are not the same unit.
- d. Documented DD-250 (or equivalent) indicating shortages and deficiencies which must be resolved prior to the FRR.

The detail requirements are covered in NPC 500-1.

2. CARR - Customer Acceptance Readiness Review for MSC End Items.

The purpose of CARR is validation of the configuration of each end item accepted for delivery. The CARR examines each spacecraft end item (hardware and software) against the specification requirements, and released engineering drawings, evaluates the system performance as obtained during checkout operations, and validates the acceptance testing. A CARR may be used in lieu of FACI if FACI requirements are satisfied. In addition, verification is made during CARR that all mission constraints are valid and the CEI is capable of the stated performance and is ready for delivery. After a complete review of the Acceptance Data Package (ADP) and completion of CARR, the first endorsement of the Certification of Flight Worthiness (COFW) and/or the DD-250 are signed.

When CARR is used in lieu of FACI it may be conducted in as many phases as required but the final phase should always be just prior to delivery. The products of a CARR include:

- a. Acceptance of Part II of the Contract End Item Specification.
- b. Assessment Review following subsystem tests.
- c. Documented DD-250 indicating shortages and deficiencies which must be resolved prior to the FRR.

C. COFW - Certification of Flight Worthiness

The purpose of the COFW checkpoint is to certify that each flight stage and module is a complete and qualified item of hardware prior to shipment and is accompanied by adequate supporting documentation. This also certifies adequacy of appropriate software at this point in time. The COFW procedure informs the Apollo Program Director of any deficiencies prior to shipment from the manufacturing site and from the static firing site.

The COFW certifies that:

1. Specs and drawings have been developed in accordance with NPC 500-1; NHB 5300.1A; Section 3, NPC 250-1 and Section 4.2, NPC 200-2. Additionally, the exact relationship of the Contract End Item as described by released engineering to the Contract End Item as manufactured and assembled has been established and that shortages which must be resolved prior to FRR have been indicated on a documented DD-250.
2. Acceptance, qualification and reliability demonstration tests have been successfully completed and meet the specification requirements.
3. Departures from specification and drawing requirements have been approved by Material Review Boards and applicable Configuration Control Board in accordance with NPC 200-2, Section 8.1, NHB 5300.1A and NPC 500-1.
4. Critical hardware and software qualification program is in accordance with NPC 250-1, Sections 3.7 and NHB 5300.1A.
5. Hardware and software qualification program is in accordance with the NPC 200-2, Sections 7.3, 7.4, 14.2 and NHB 5300.1A.
6. Hardware and software is complete and in accordance with the Narrative End Item Report in accordance with NPC 200-2, Section 14.2.4 and NHB 5300.1A.
7. Data for operation and checkout is complete and compatible.
8. Shipping requirements of NPC 200-2, Section 11.6 and NHB 5300.1A have been met.

NOTE: FACI, CARR and DD-250 data requirements applicable to the COFW shall be used for the COFW. Detail requirements for COFW are contained in NHB 8080.1.

D. DCR - Design Certification Review (See reference f)

The DCR will be scheduled for applicable missions by a letter signed by the Associate Administrator for Manned Space Flight.

The purpose of the DCR checkpoint is to certify the design of the total space vehicle system and mission flight complex for flight worthiness and manned flight safety by a thorough formal review of the development and qualification of all stages and modules and their installed subsystems. Data to be reviewed at the DCR shall include the following:

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1. Design Description

- a. Mission Requirements/Design Requirements
- b. Mission Capability
- c. Mission Constraints
- d. Design Configuration and Interface Compatibility
- e. Design Safety Evaluation
- f. Configuration Deltas Over Flight Tested Hardware
- g. Proposed Future Modification

2. Design Verification

- a. Design Requirements/Test Requirements
- b. Test Programs
 - (1) Identification of Test Program
 - (2) Test Program Conditions and Control Disciplines
 - (3) Test Results in Summary
- c. Flight Verification
- d. Failure History of Items Experiencing Repeated Failures
- e. Corrective Action on DCR and FRR Open Action Items and Open Mission Anomalies

3. Critical Technical Areas of Concern

4. MSF Operations Support

5. MSF Program Managers Assessment

6. Operational Safety Review

NOTE: FACI, CARR, COFW and DD-250 data requirements applicable to the DCR shall be used for the DCR.

E. FRR - Flight Readiness Review (See reference g)

The FRR will be scheduled for each mission by a letter signed by the Program Director.

The purpose of the FRR checkpoint is to determine that the space vehicle hardware and software and launch complex are ready to commence the mission period. This determination involves the review of:

1. Launch Vehicle Readiness Assessment
2. Spacecraft Readiness Assessment
3. Launch Complex Readiness Assessment
4. The Manned Space Flight Network
5. Flight Control
6. Flight Crews
7. Recovery Planning
8. Medical Planning
9. Public Information Planning

The following items should be considered in the review at this time:

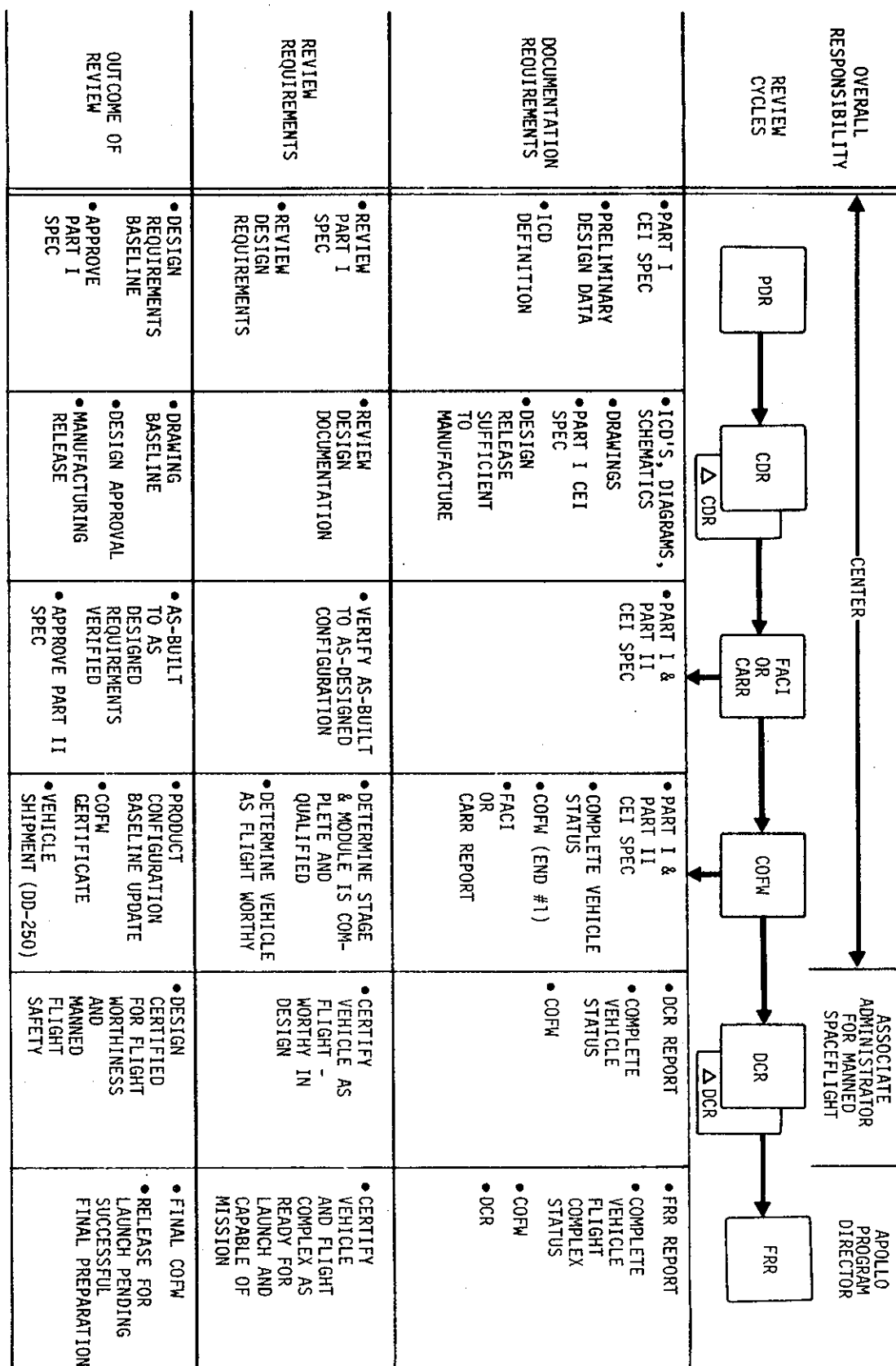
1. The checkout and qualification test status of all hardware and software.
2. The summary of failures and the disposition of the failures, with particular emphasis on failures that have occurred during the pre-launch and checkout phase where records indicate a previous failure history.
3. All modifications, deviations and waivers. A certification that the space vehicle hardware and software end items are described by officially released engineering and that all required engineering changes after hardware and software delivery from the factory or contractor have been installed.

The review compares the status of major operational elements of the mission with requirements outlined in the Mission Operations Plan and the Support Requirements Planning Document which are developed in accordance with the PDP.

NOTE: FACI, CARR, COFW, and DCR data requirements applicable to the FRR shall be used for the FRR.

RESPONSIBILITIES

The conduct of the PDR, CDR, FACI, CARR and COFW is the responsibility of the Center having development responsibility for the end item. The conduct of the DCR is the responsibility of the Associate Administrator for Manned Space Flight. The conduct of the FRR is the responsibility of the Apollo Program Director.



REVIEWS AND INSPECTIONS
FIGURE 1

DATE

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M-D MA

1400.105

(Project)

OFFICE OF MANNED SPACE FLIGHT
PROGRAM DIRECTIVESEQUENCE AND FLOW OF HARDWARE DEVELOPMENT
AND KEY CHECKPOINTS

DESIGN	MANUFACTURE & C/O		STATIC FIRING & C/O		STAGE & MODULE INTEGRATED TESTS (KSC)		PRE-LAUNCH C/O & COUNTDOWN	
	FACTORY		SITE TESTING					
PDR	CDR	CARR OR FACI COFW (STAGE & MODULES)	COFW (STAGES)	DCR	FRR			
KEY REVIEW, INSPECTION, CERTIFICATION REQUIREMENTS								
PDR	SPEC	DWGS	HARDWARE	SOFTWARE	TEST RESULTS	QUALITY HIST. RECORDS	REL. STATEMENT	FAILURE SUMMARY
PDR	PART I							
CDR	PART I	X						
FACI, CARR	PART II	X	X	X	X	X		
COFW	X	X,	X	X	X	X		
DCR	X				X		X	X
FRR					X	X	X	X

FIGURE 2

UNITED STATES GOVERNMENT

Memorandum

JMM

TO : Distribution

DATE: FEB 4 1969

FROM : Apollo Program Manager, AP

SUBJECT: APD #6B, dated December 2, 1968, "Key Inspection, Review and Certification Checkpoints and Their Documentation"

Reference: Briefing Note to Dr. Debus from AP, dated January 30, 1969, same subject, with attachment: APD #6B, "Key Inspection, Review and Certification Checkpoints and Their Documentation"

1. APD #6B has been reviewed by AP. The KSC impact is summarized in the reference, see attached copy. APD #6B supersedes APD #6A.
2. Since APD #6B is a reiteration and clarification of existing Center procedures, no new compliance actions by KSC appear necessary. Therefore, APD #6B is forwarded for your information only.
3. Comments you may have pertinent to the present KSC posture in regard to APD #6B should be directed to the Chief, AP-SYS, prior to February 28, 1969.

R. O. Middleton

R. O. Middleton
Rear Admiral, U. S. Navy

Attachment: As stated

Distribution:
STD-L-B

cc:
Dr. Debus, CD
Mr. Murphy, EX



5010-108

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BRIEFING NOTE TO: Dr. Debus

1969

SUBJECT: APD #6B, dated December 2, 1968, "Key Inspection, Review and Certification Checkpoints and Their Documentation"

1. APD #6B identifies, lists and briefly describes key inspections, reviews and certifications required as control checkpoints for the Apollo Program. The checkpoints are oriented toward the hardware and software development and mission phases of the program to assure adequacy of the design, manufacture and testing prior to mission accomplishment. Guidance and direction provided by APD #6B is described briefly below:

- a. Establishes the key program milestone checkpoints.
- b. Defines the requirements for each checkpoint as oriented to the program hardware and software.
- c. States the applicability of each key checkpoint to either Contract End Item (CEI) level or to the total system.
- d. Defines procedures and review or certification documentation for each key checkpoint.
- e. Provides that Contractor Acceptance Readiness Review (CARR) for spacecraft hardware and software may be used in lieu of First Article Configuration Inspection (FACI) provided that the FACI requirements are satisfied.
- f. Identifies the responsibilities for conduct of each of the key checkpoint reviews.

2. Implementation of APD #6B should not have any impact on KSC management or operations since it is a reiteration and clarification of existing Center procedures.

3. Limited distribution of this APD will be made to key KSC personnel along with a copy of this briefing note.

R. O. Middleton
R. O. Middleton
Rear Admiral, U. S. Navy

Thanks!
(Dr. Debus 1/31/69)